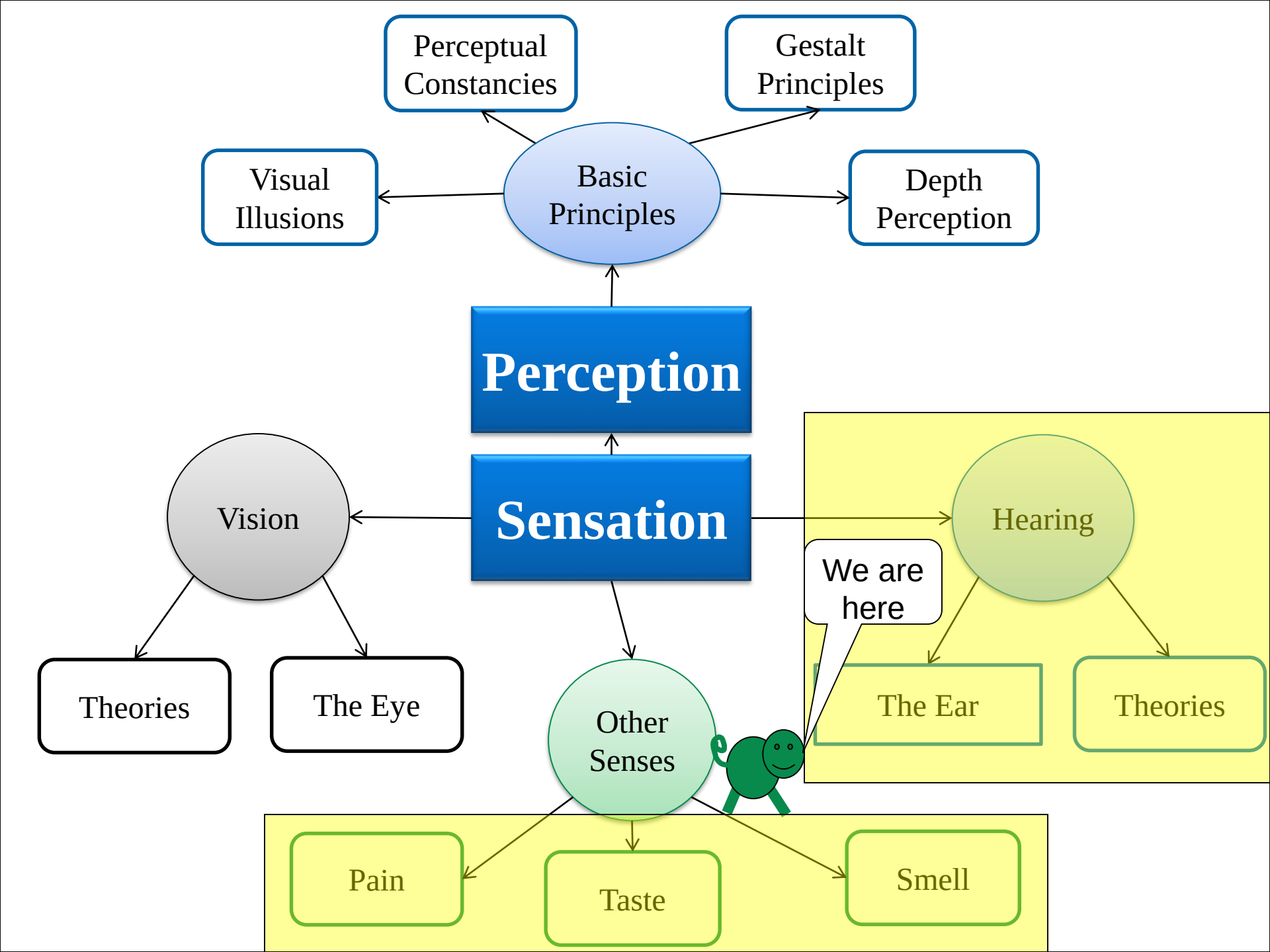
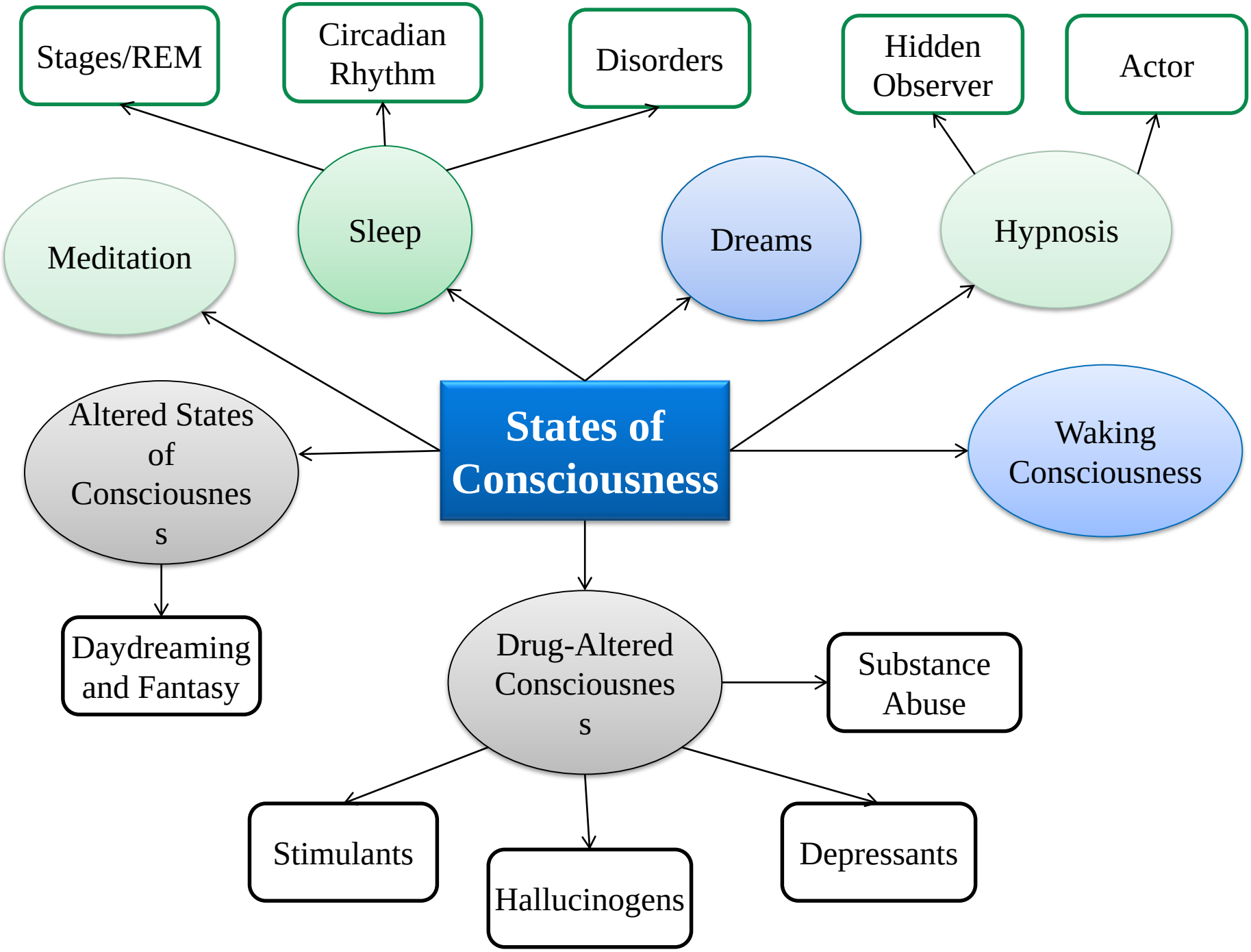
WHS AP Psychology

Unit 4: Sensation, Perception and States of Consciousness

Essential Task 4-3: Describe the other sensory processes (e.g., hearing, touch, taste, smell, vestibular, kinesthesis,pain), including the specific nature of energy transduction (Frequency Theory, Place Theory ,Volley Principle, Gate Control Theory) relevant anatomical structures, and specialized pathways in the brain for each of the senses.


Perceptual Constancies
Gestalt Principles
Visual Illusions
Basic Principles
Depth Perception
Perception
Sensation
Vision
Hearing
We are here
Theories
The Eye
Other Senses
The Ear
Theories
Pain
Taste
Smell


States of Consciousness
Sleep
Stages/REM
Circadian Rhythm
Disorders
Dreams
Meditation
Hypnosis
Hidden Observer
Actor
Altered States of Consciousness
Daydreaming and Fantasy
Waking Consciousness
Drug-Altered Consciousness
Substance Abuse
Stimulants
Hallucinogens
Depressants

Essential Task 4-3:

Outline

- Describe the other sensory processes
  - Hearing
    - Relevant anatomical structures
    - Sound Localization
    - Theories of Hearing
      - Place Theory vs. Frequency Theory (Volley Principle)
  - Taste
  - Smell
  - Touch and pain
    - Gate Control Theory
  - Vestibular
  - Kinesthesis and proprioception

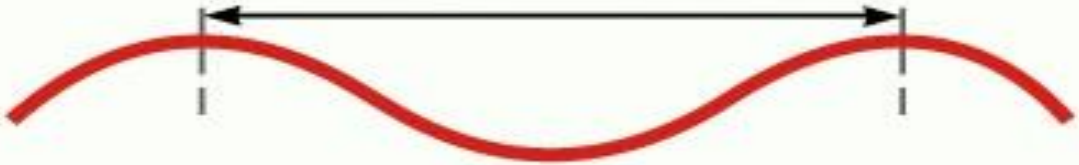
Audition

- Audition – is the sense or act of hearing
- Sound waves – Rhythmic movement of air molecules
- Frequency – the number of complete wavelengths that pass a point in a given time (per second, megahertz)
- Pitch – Higher or lower tone of a sound; it depends on frequency

Frequency

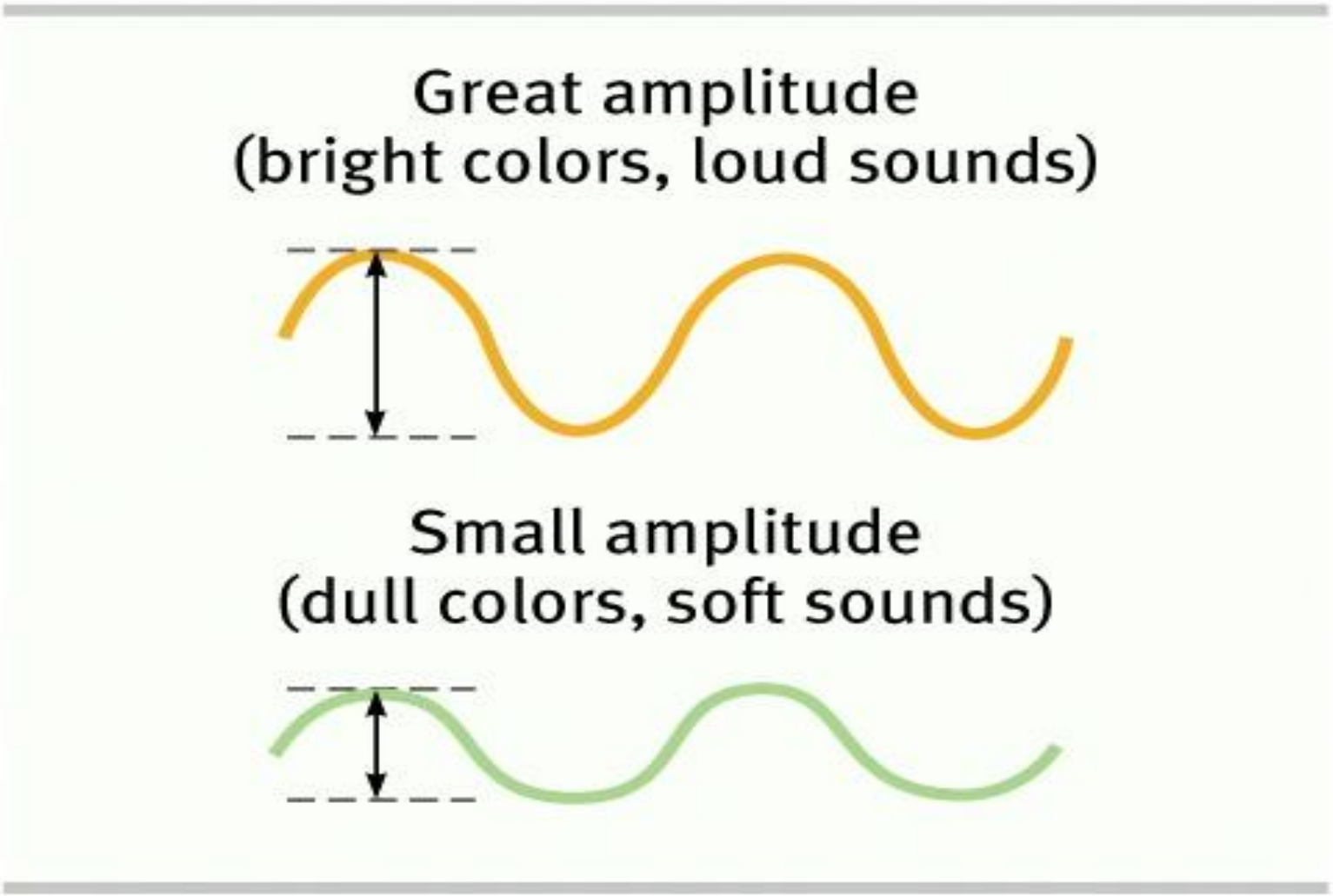
Short wavelength = high frequency
(bluish colors, high-pitched sounds)

Long wavelength = low frequency
(reddish colors, low-pitched sounds)



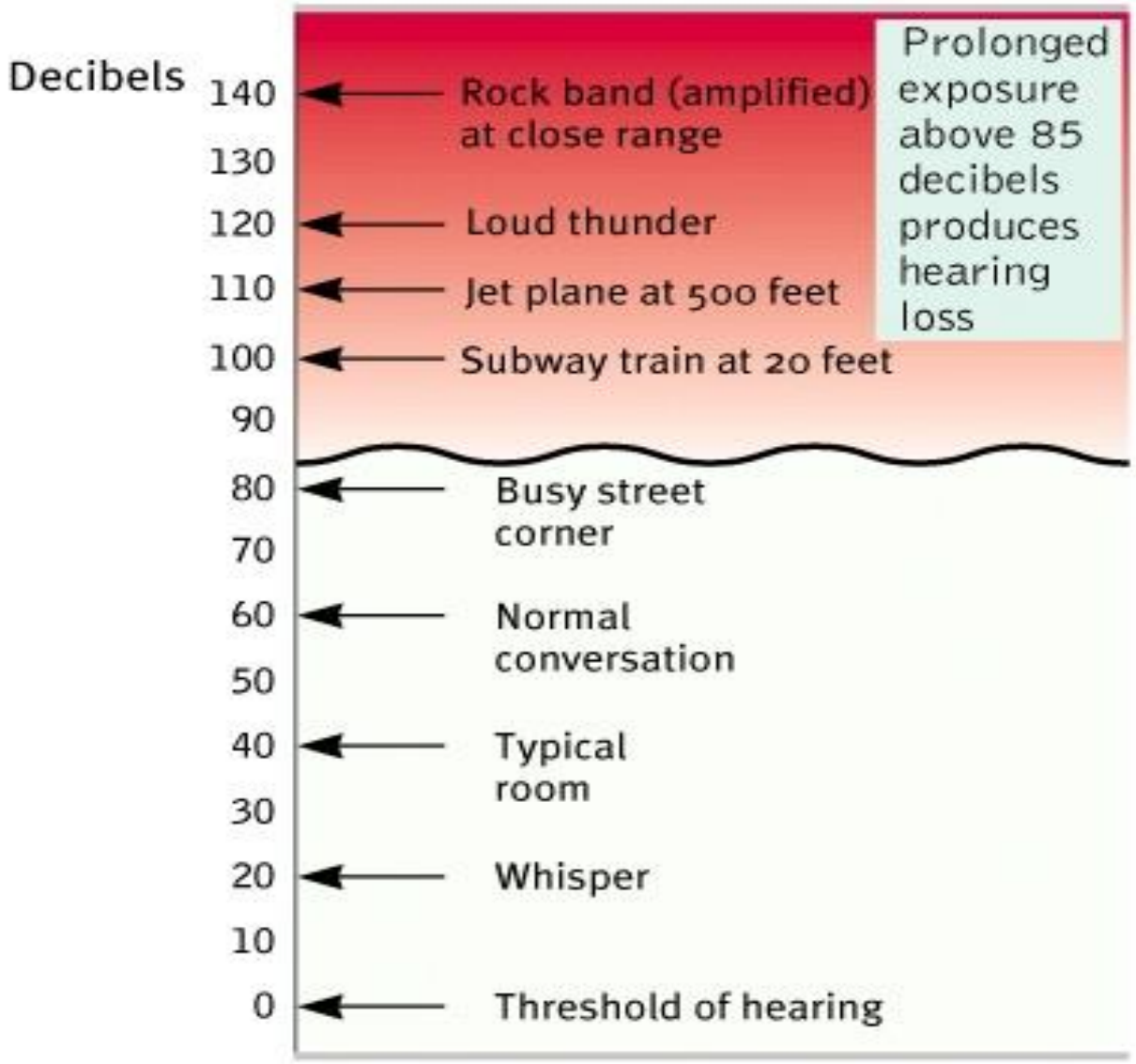
(a)

Amplitude


Great amplitude
(bright colors, loud sounds)
Small amplitude
(dull colors, soft sounds)

(b)

Sound intensity – Loudness



Ear Parts

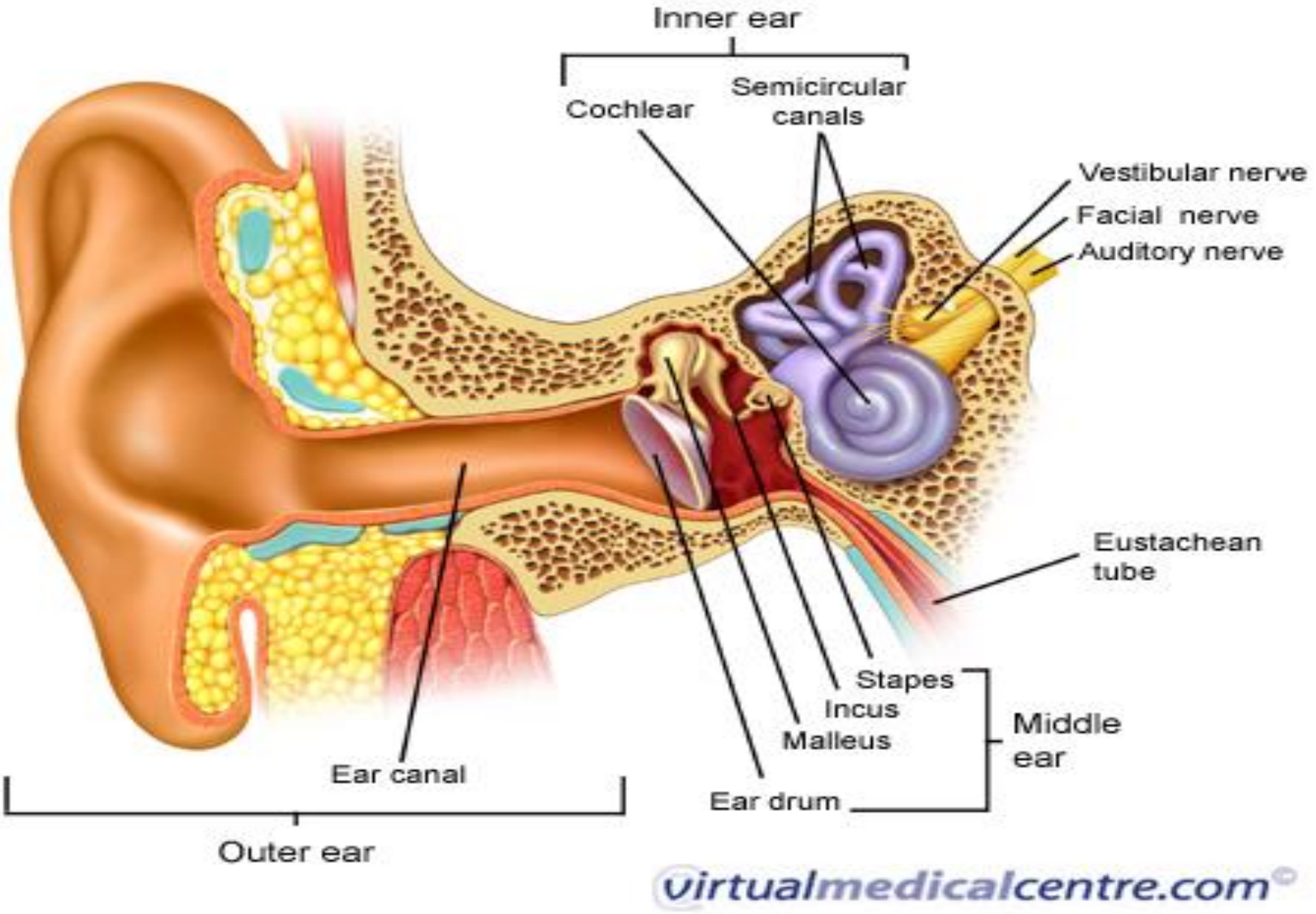
- Pinna – external part of the ear
- Auditory canal – inner ear; the narrow passageway from the outer ear to the eardrum
- Tympanic membrane – Eardrum
- Auditory ossicles – three small bones that vibrate; link ear drum with the cochlea
  - Malleus (hammer)
  - Incus (anvil)
  - Stapes (stirrup)
    - MIS HAS

Ear Parts

- Oval window
- Cochlea – snail-shaped organ that makes up the inner ear; it contains the cilia
- Cilia (Stereocilia) – Hair cells/receptor cells within the cochlea that transduce vibration into nerve impulses
- Basilar membrane – inner surface of the cochlea that contains the hair cells

The Ear!

Outline

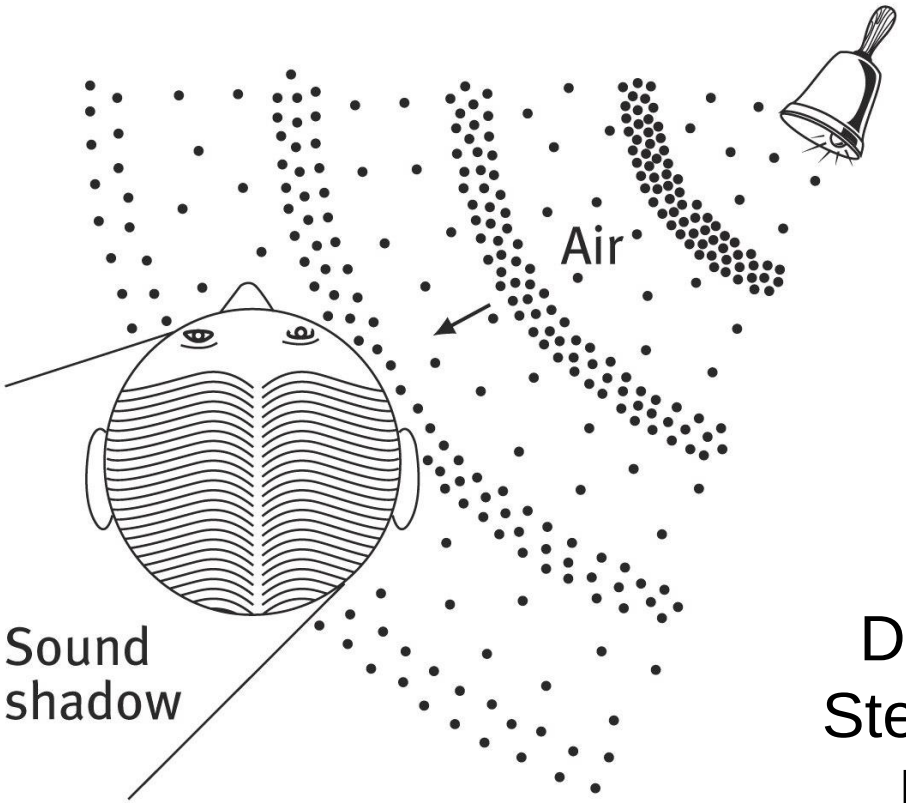


https://www.youtube.com/watch?v=PeTriGTENoc

Sound Localization

Outline

Because we have two ears, sounds that reach one ear faster than the other ear cause us to localize the sound.



Directional
Stereophonic
Hearing

Theories of Hearing

Outline

- Place theory
  - Pitch (how high or low something is) is determined by location of vibration along the basilar membrane
  - But this doesn't explain low-pitch since we haven't found specific positions for those on the basilar membrane
  - Explains high pitch

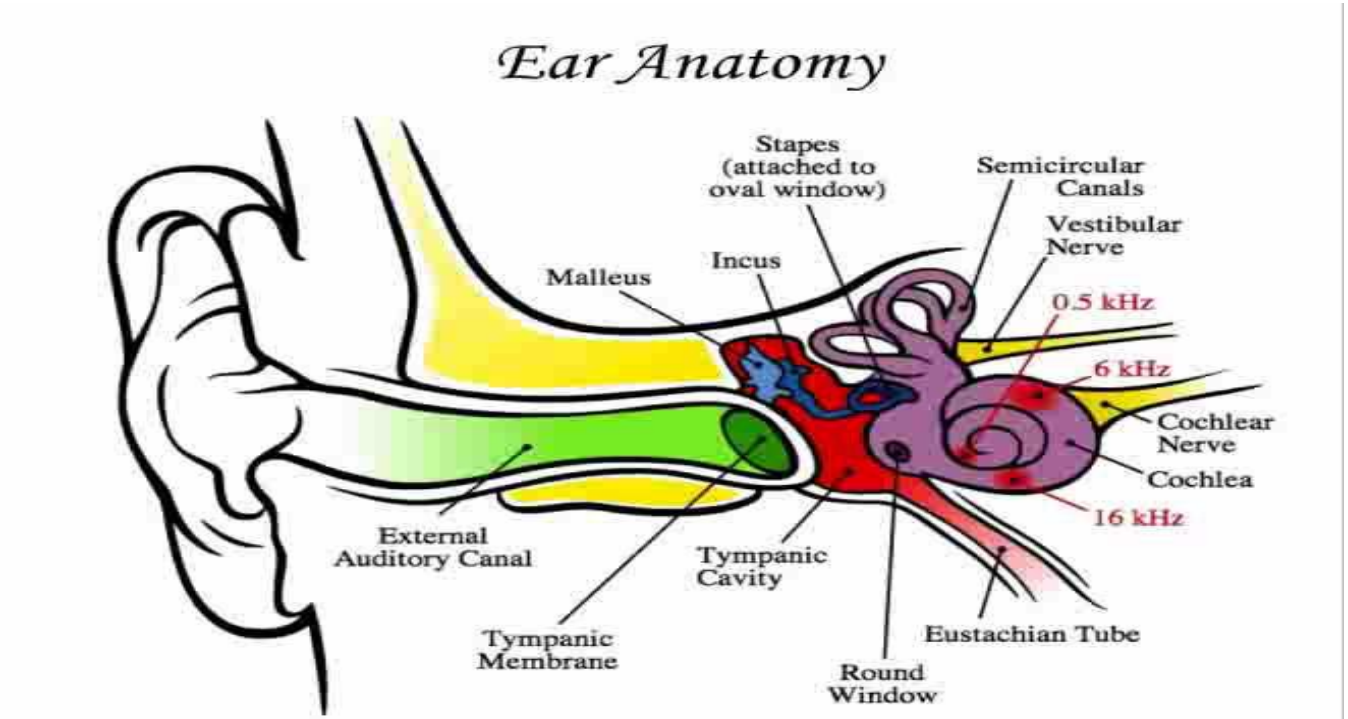


Image courtesy http://upload.wikimedia.org/wikipedia/commons/3/34/

Theories of Hearing

- Frequency theory (Pitch perception)
  - all sounds are encoded to the brain by neurons firing at a rate that mimics the frequency of the sound.
  - Pitch is determined by frequency hair cells produce action potentials
  - Example if the frequency of the sound is 100 waves per second then the neuron fires at 100 pulses per second.
  - But we can hear frequencies above 1000 waves per second but can't fire neurons faster than 1000 pulses per second.
  - Theory explains low pitch
  - But it does not explain high pitch
- Volley Principle
  - Pattern of sequential firing creates a combined high frequency signal

- Volley Principle
  - when high frequency sounds are experienced too frequently for a single neuron to adequately process and fire for each sound event, the organs of the ear combine the multiple stimuli into a "volley" in order to process the sounds.

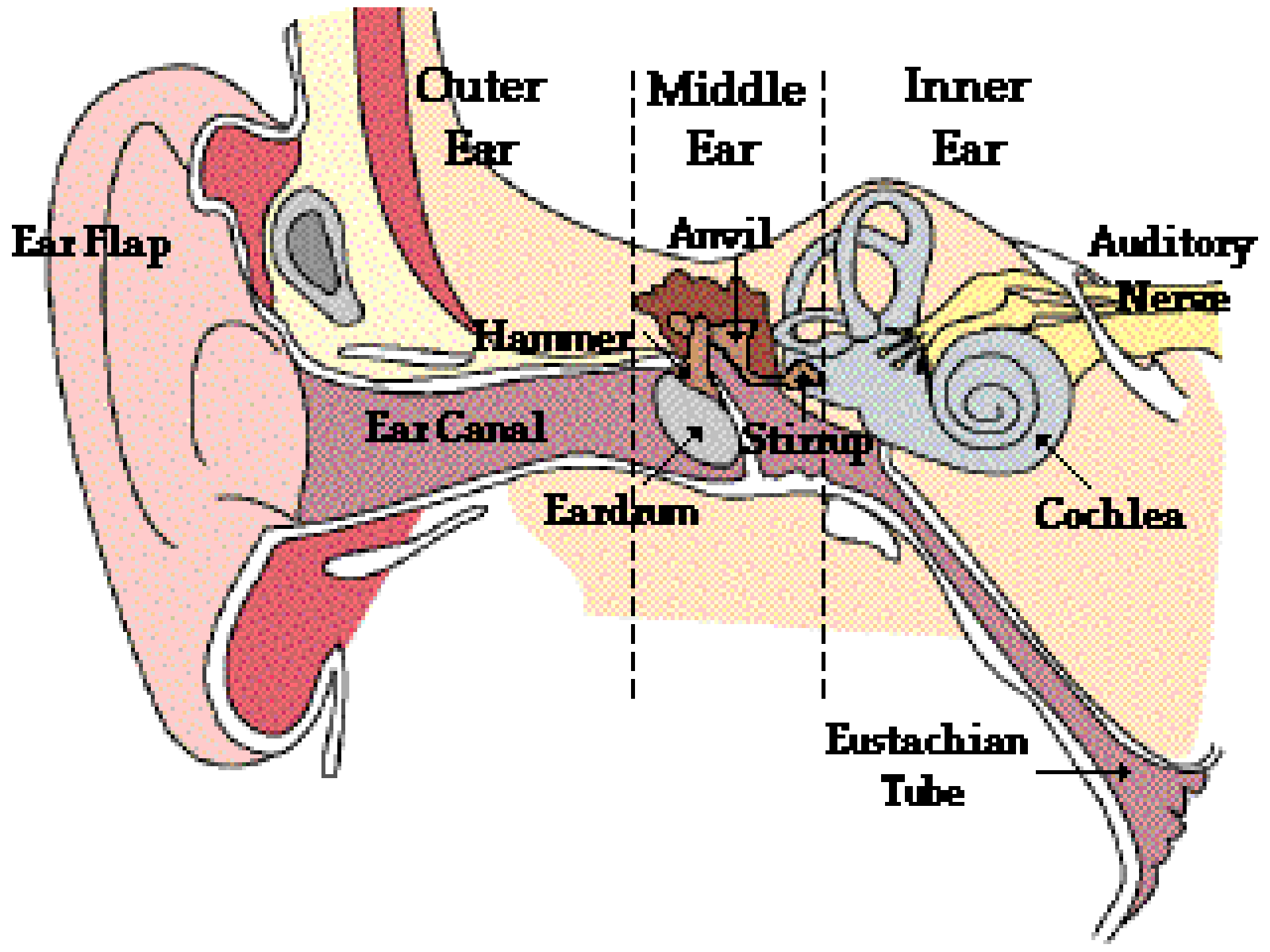
Auditory Frequencies

- What is the audiable range for humans?
- 20-20,000 Hz (20-20,000 vibration per sound)
  - 1 Hz is 1 vibration per sound
- Ultrasound (Higher frequency) we cannot perceive – beyond our upper limits
  - Dog whistles
- Infrasound – lower frequency we cannot perceive

Hearing Loss

Outline

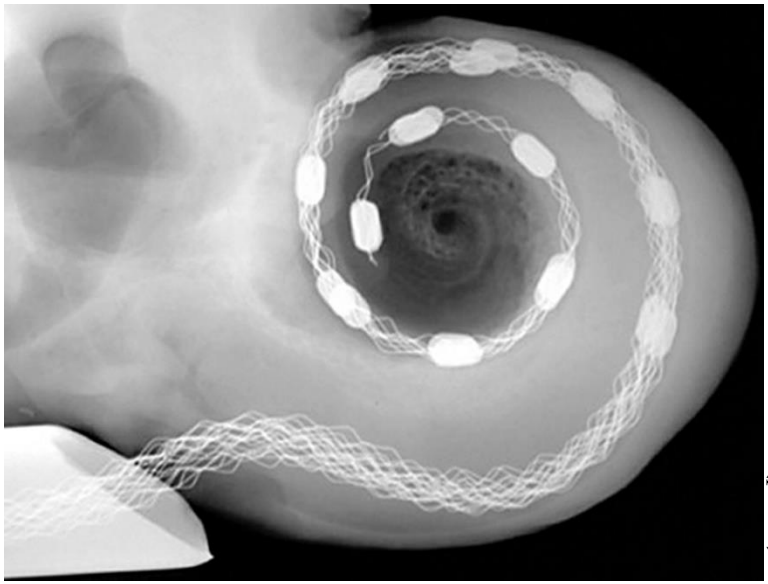
- Conduction Hearing Loss: Hearing loss caused by damage to the mechanical system (tympanic membrane to the middle ear) that conducts sound waves to the cochlea.
  - Surgery
- Sensorineural Hearing Loss: (nerve deafness) Hearing loss caused by damage to the cochlea's receptor cells or to the auditory nerve, also called nerve deafness.
  - Hearing aid to amplify sound
  - Cochlear Implant


Outer Ear
Middle Ear
Inner Ear
Ear Flap
Anvil
Auditory Nerve
Hammer
Ear Canal
Stirrup
Eardrum
Cochlea
Eustachian Tube

Cochlear Implants

Outline

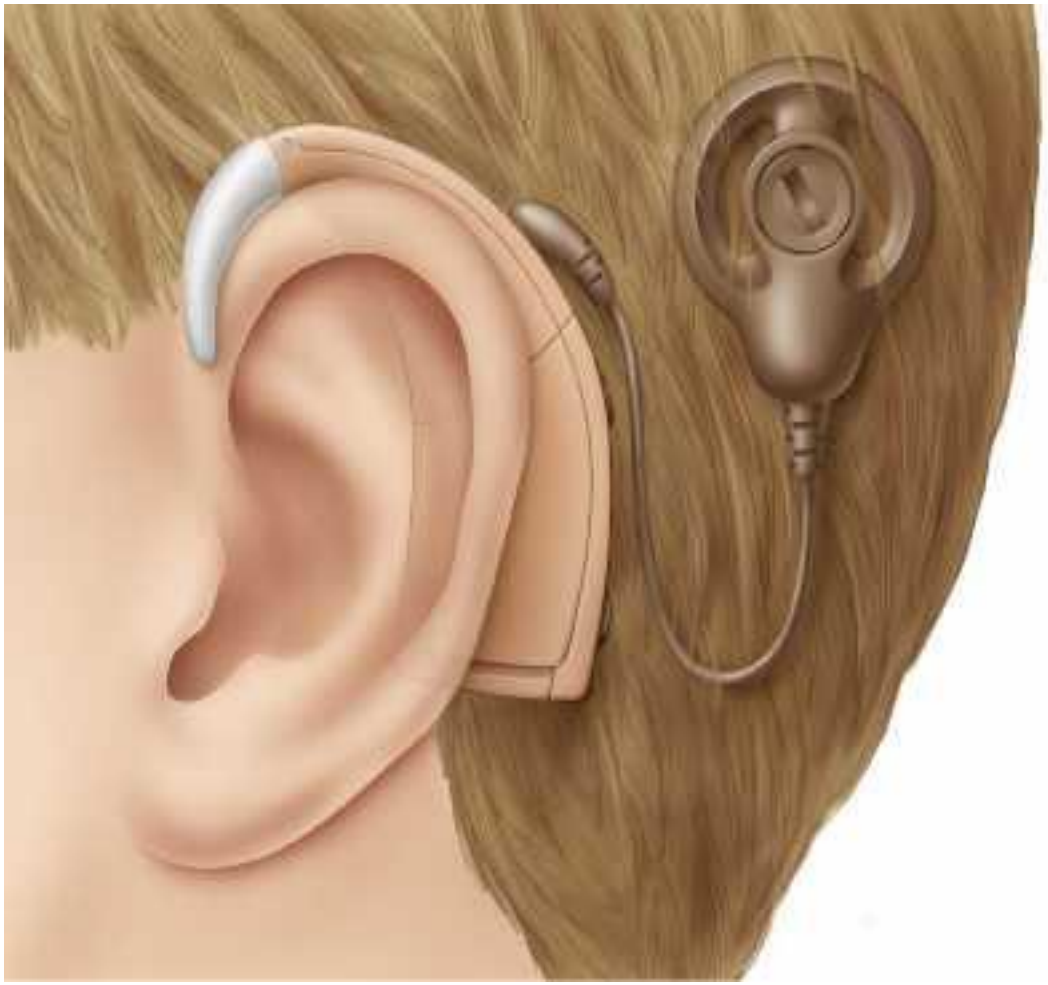
Cochlear implants are electronic devices that enable the brain to hear sounds.

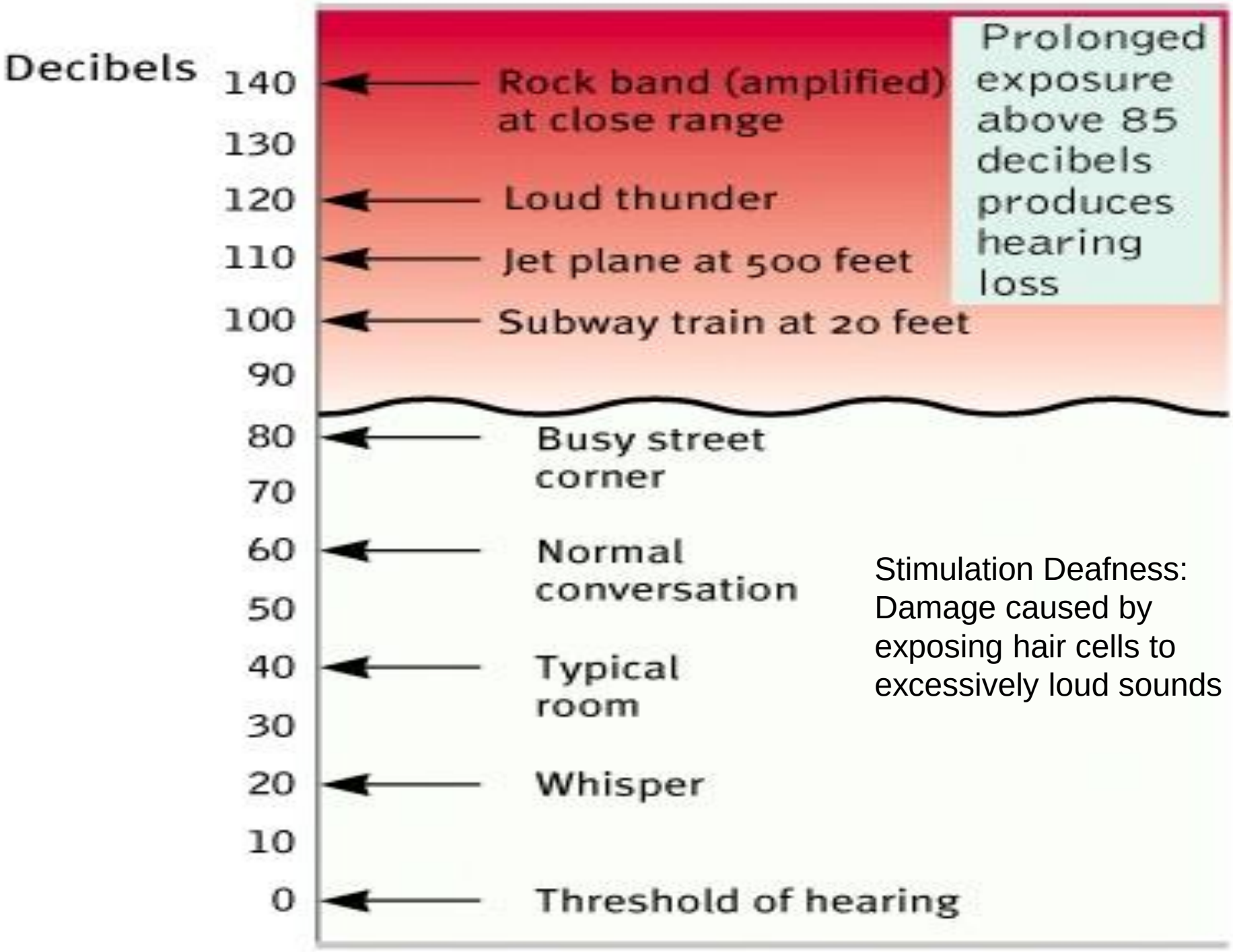


Wolfgang Gstottner. (2004) *American Scientist*, Vol. 92, Number 5. (p. 437)

Cochlear Implant

Cochlear implant





Stimulation Deafness: Damage caused by exposing hair cells to excessively loud sounds

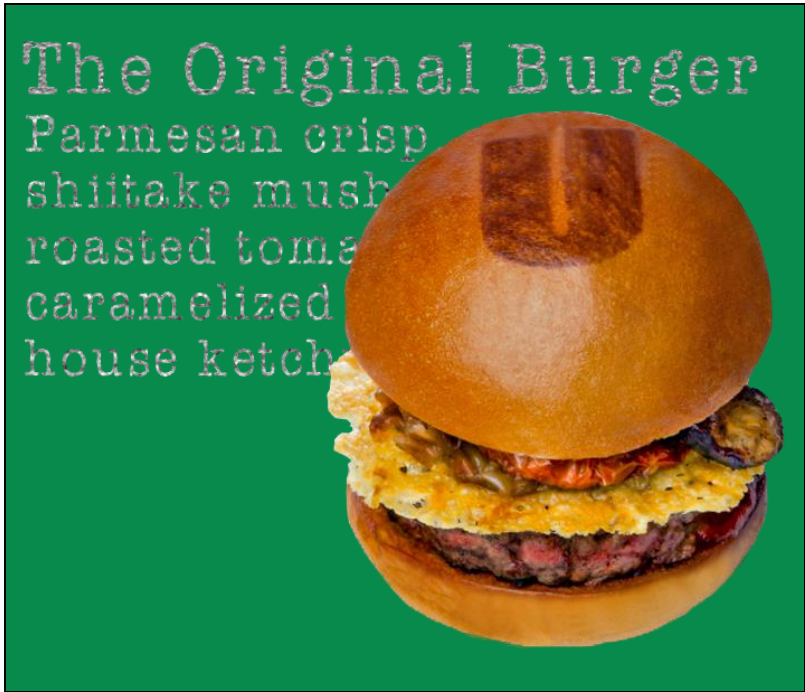
Gustation: Sense of Taste

Outline

- Chemo sense (chemicals)
- Papillae – taste receptor cells
- Five basic tastes
  - Sweet – source of energy (carbs)
  - Salty – sodium
  - Sour – potentially toxic
  - Bitter – potentially toxic and poisonous
  - Umami – protein Japanese word meaning pleasant savory meaty (brothy) taste. People taste umami through receptors for glutamate, commonly found in its salt form as the food additive monosodium glutamate (MSG)

Oh Mommy Umami

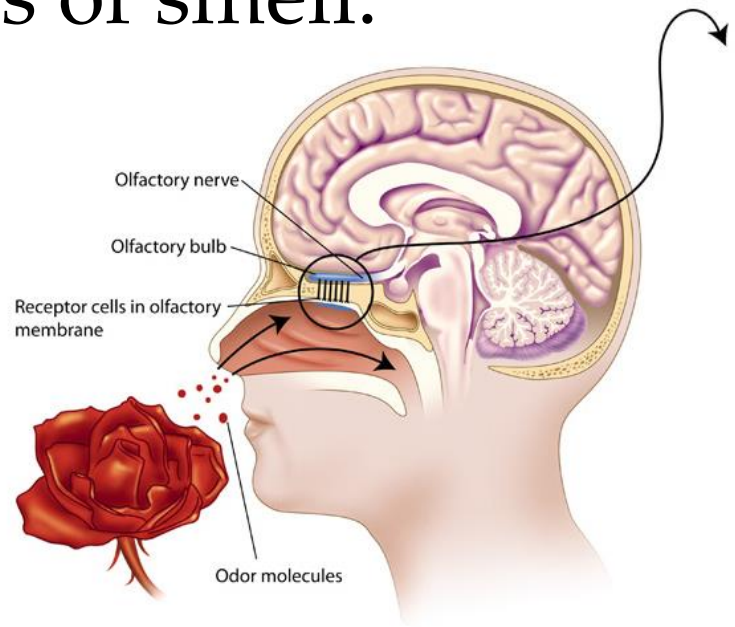
Outline



Olfaction (Sense of Smell)

Outline

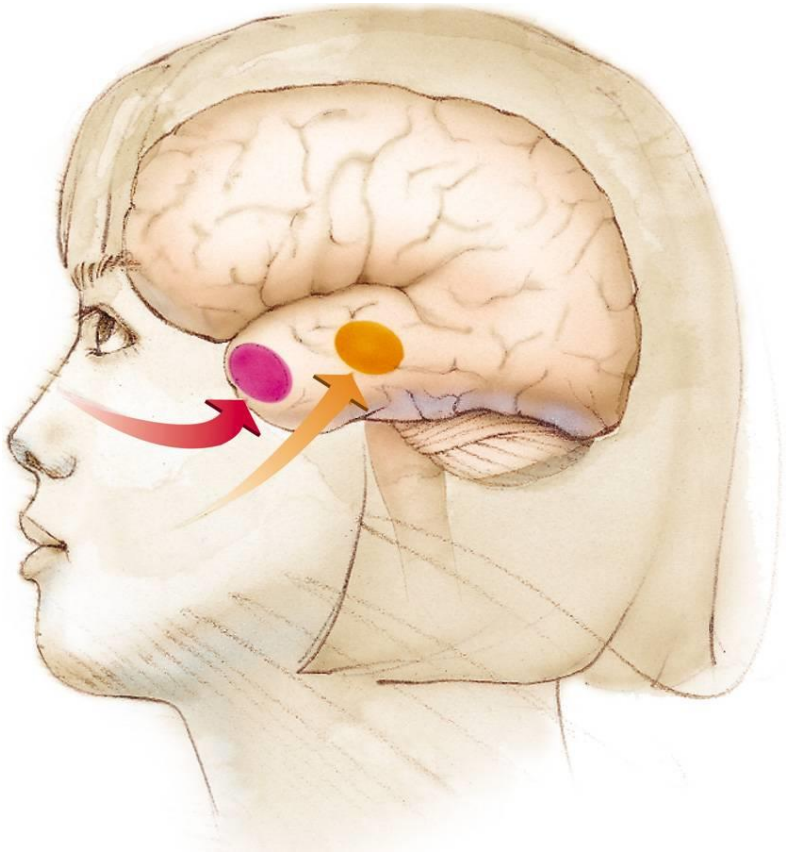
Like taste, smell is a chemical sense. Odorants enter the nasal cavity to stimulate 5 million receptors to sense smell. Unlike taste, there are many different forms of smell.



Smell and Memories

Outline

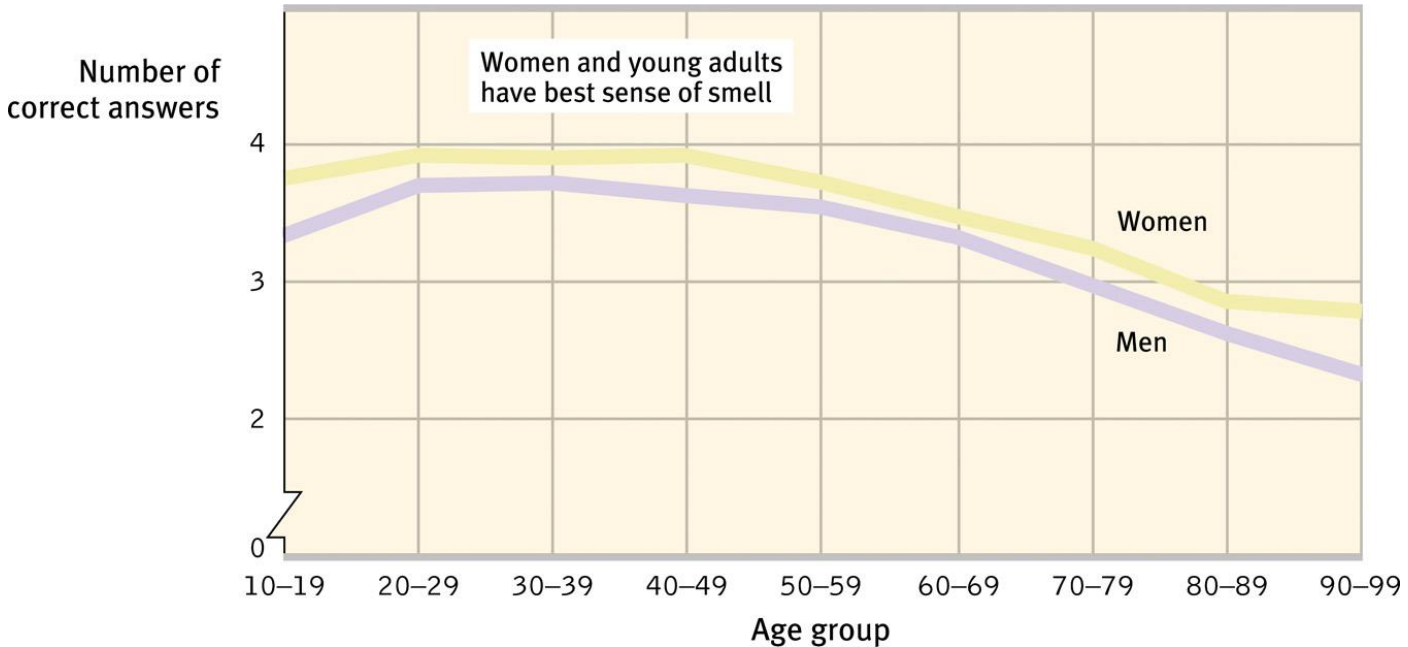
The brain region for smell (in red) is hard wired into brain regions involved with memory (limbic system – amygdala and the hippocampus). That is why strong memories are made through the sense of smell.



Age, Gender, and Smell

Outline

Ability to identify smell peaks during early adulthood, but steadily declines after that. Women are better at detecting odors than men.



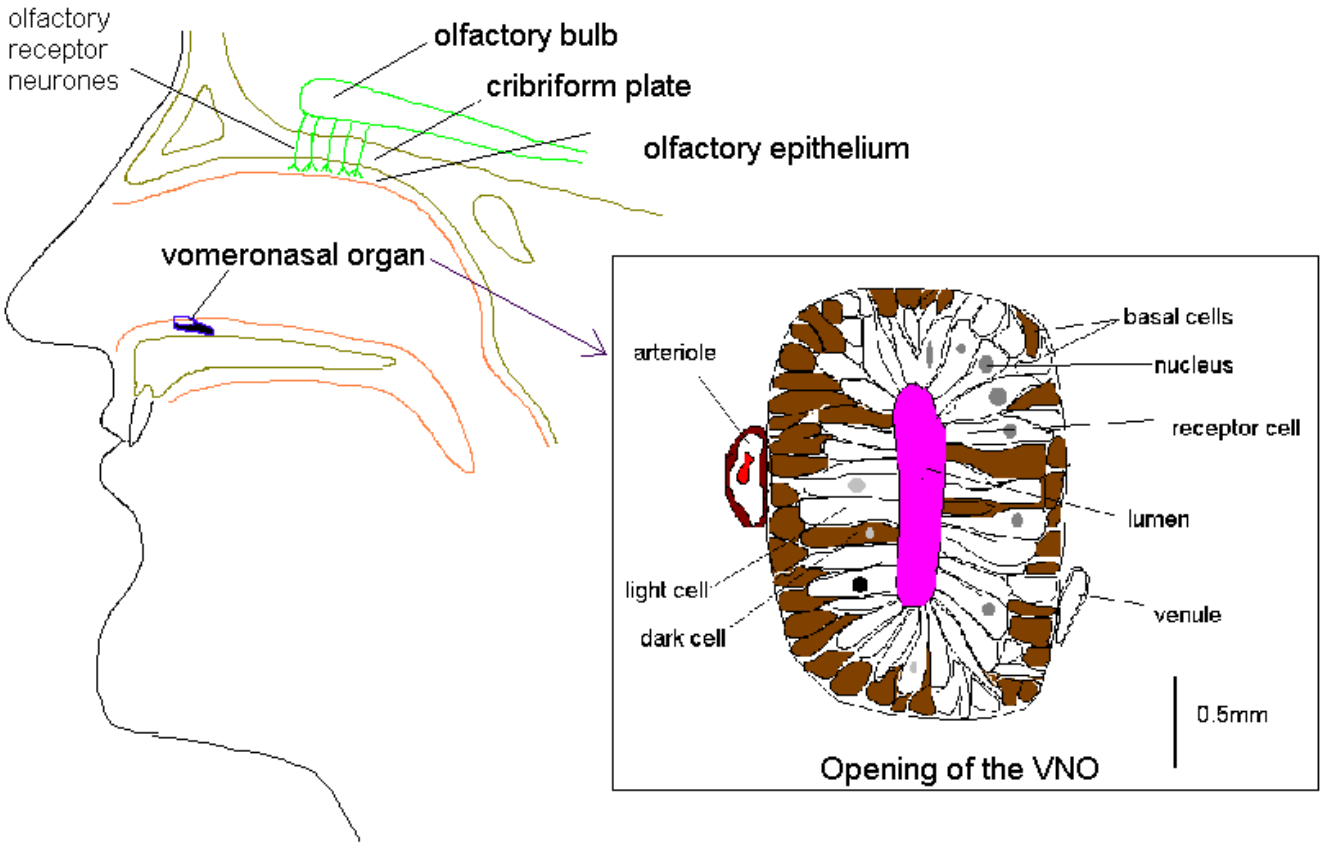
Smell

Outline

- Lock and key theory
  - Odors are related to shapes of chemicals and molecules
- **Anosmia**
  - Complete loss of the ability to smell
- Pheromones
  - Used by animals as a form of communication
  - Also provides information about sexual receptivity
  - Provides information about genetic identify MHC (The major histocompatibility complex (MHC) is a set of cell surface molecules encoded by a large gene family which controls a major part of the immune system in all vertebrates.)
  - Pheromones stimulate the vomeronasal organ (VNO)
  - Information from the VNO is sent to a special part of the olfactory bulb used for pheromonal communication

Vomeronasal Organ

Outline



Touch

Outline

- Skin is the largest sense organ
- There are receptors for pressure, temperature, and pain
- Touch appears to be important not just as a source of information, but as a way to bond with others
- Touch Localization
  - Touch localization depends on the relative lengths of the pathways from the stimulated parts to the brain.

The Skin

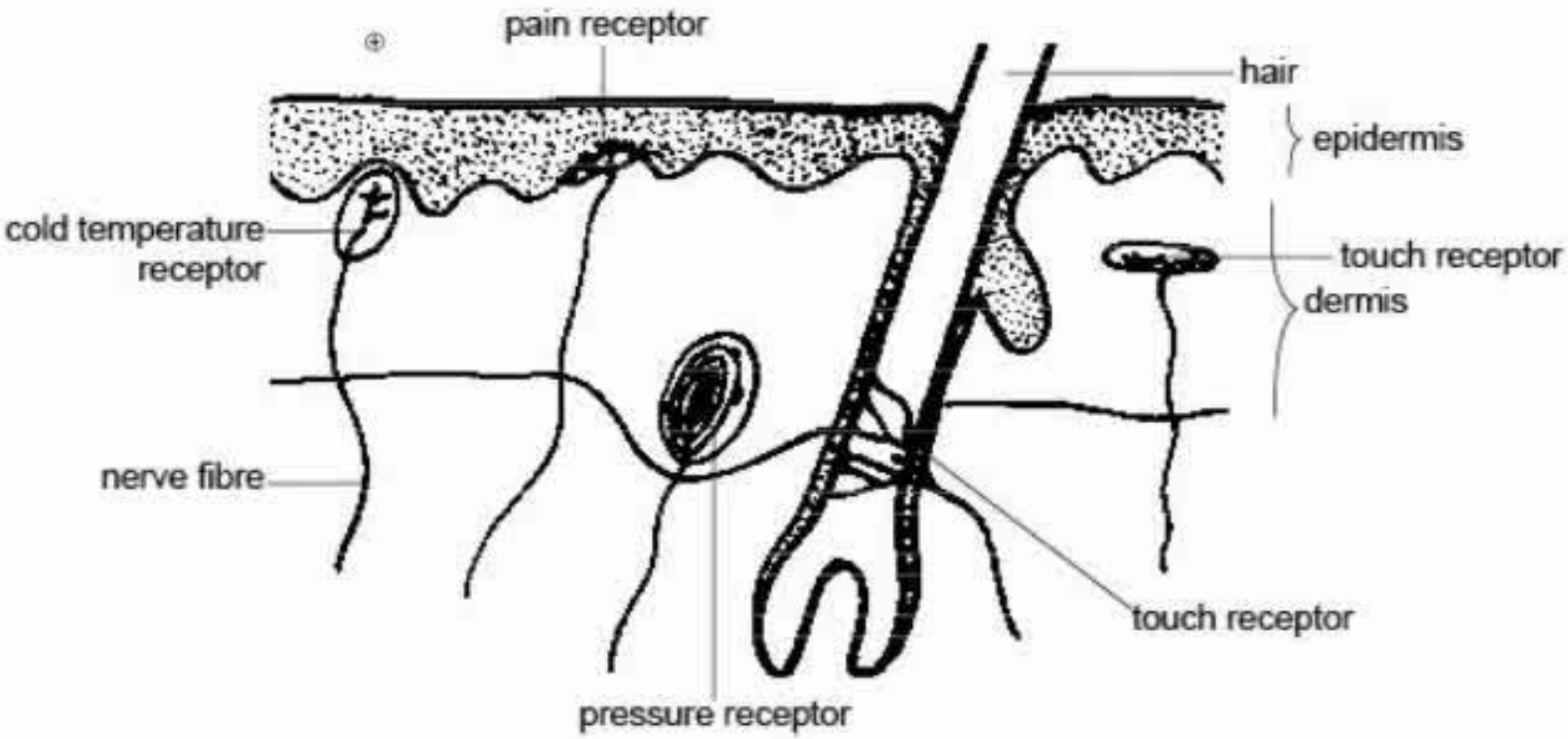


Image courtesy: http://commons.wikimedia.org/wiki/File:Anatomy_and_physiology_of_animals_General_senses_in_skin.jpg

Pain

Outline

Pain tells the body that something has gone wrong. Usually pain results from damage to the skin and other tissues. A rare disease exists in which the afflicted person feels no pain.

AP Photo/ Stephen Morton

Ashley Blocker (right) feels neither pain nor extreme hot or cold.

Revised Reducer-Augmenter Scale

Outline

- Total scores can range from 21 to 126, with lower scores reflecting a tendency toward "reducing" and higher scores reflecting a tendency toward "augmenting."
- People with low pain tolerance have a nervous system that amplifies, or augments, sensory stimulation. People with **high pain** tolerance have a nervous system that dampens, or **reduces**, the effects of sensory stimulation.

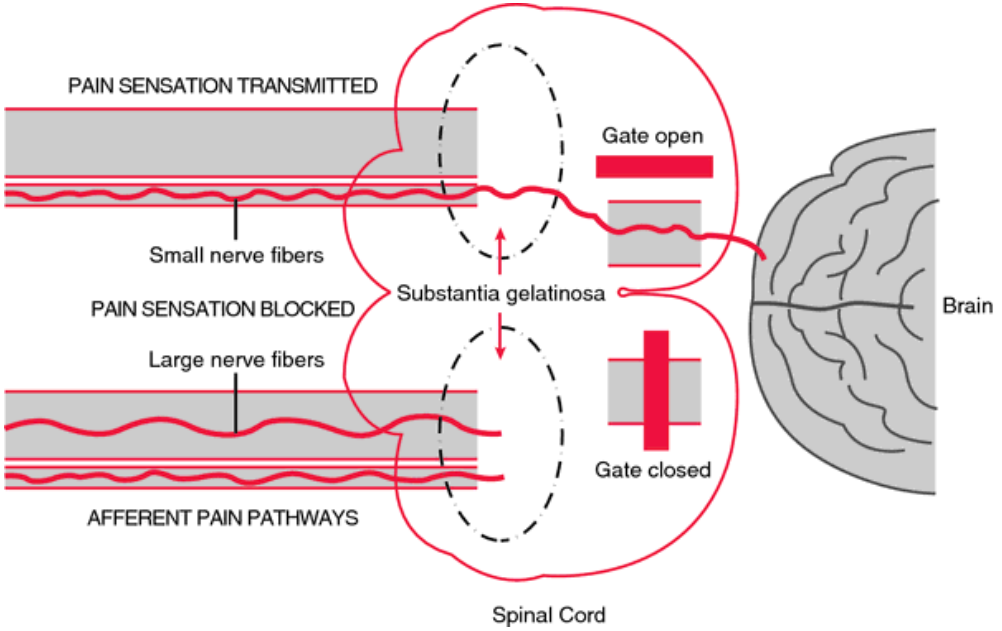
Types of Pain

- Visceral Pain – Pain orginating in internal organs
- Somatic Pain – Sharp, bright, fast; comes from skin, joints, muscles
- Phantom Limb – Missing limb feels as if it is still present
- Warning system – Pain carried by large nerve fibers to tell damage might be occurring
- Reminding System – Small nerve fibers reminds your body has been injured

Gate-Control Theory

Outline

Melzak and Wall (1965, 1983) proposed that our spinal cord contains neurological "gates" that either block pain or allow it to be sensed.



Gate Control Theory

Outline

- Spinal cord contains small nerve fibers that conduct most pain signals
- It also contains larger fibers that conduct most other sensory signals
- When tissue is injured small nerve fibers activate and open the neural gate
- Large fiber activity shuts that gate
- Thus if you stimulate gate closing activity by massage electrical signal or acupuncture you can disrupt the pain message.
- The brain can close this gate too!

Gate Control Theory

- Sensory and pain messages are afferent and they all travel through the same neural gate in the spinal cord
- If the gate is closed due to another sensory or pain message, the other message cannot get through.
- Example: what do you do when you're itchy? You scratch the spot. The sensation of scratching blocks the itch.

Biopsychosocial Influences

Outline

Biological influences
- activity in spinal cord's large and small fibers
- genetic differences in endorphin production
- the brain's interpretation of CNS activity

Psychological influences

Social-cultural influences
- presence of others
- empathy for others' pain

Personal experience of pain

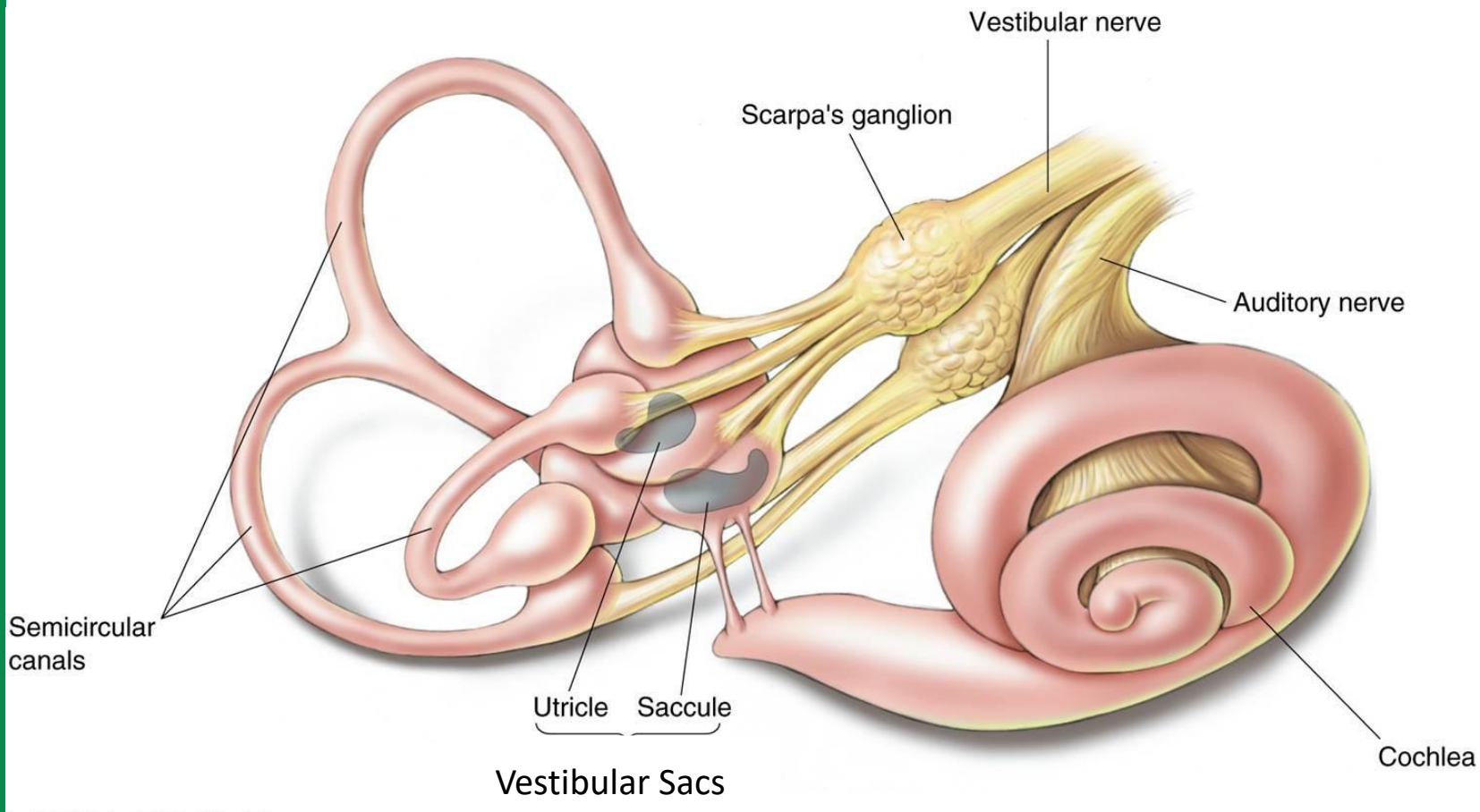
Vestibular Senses

Outline

- Vestibular senses provide information about equilibrium (balance) and body position
  - Kinesthetic Sense: Gymnasts; dancers; divers
- Fluid moves in two vestibular sacs
- Vestibular organs are also responsible for motion sickness
- Sensory Conflict Theory -- Motion sickness may be caused by discrepancies between visual information and vestibular sensation
  - Fluids in the canals are still spinning… but the head is not

Vestibular Sacs

Outline



Vestibular Sacs

Why do we feel dizzy? Why do we get Motion Sickness?

Outline

- The inner parts are open spaces filled with fluid. The inside walls of the spaces are covered with tiny hairs. Each hair is connected to a nerve cell that carries signals to the brain. When the head moves, the fluid sloshes around and bends the hairs. As each hair bends, it makes its nerve cell send a signal, telling the brain about that movement.

- When we spin around, the fluid starts spinning, too. That gives us the sensation of spinning. When we stop, the fluid keeps moving (and bending tiny hairs and signaling the brain). That may make us feel that we are spinning backward. We call that "feeling dizzy."

Proprioception/Kinesthetic Sense

Outline

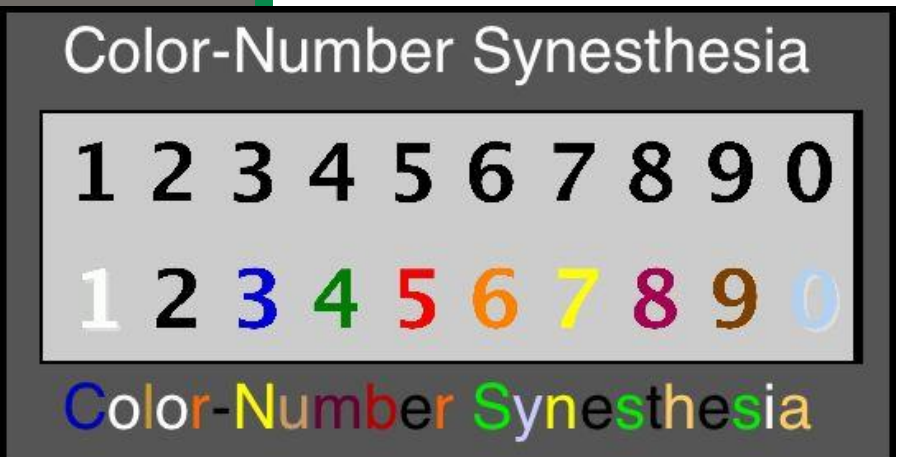
- from Latin proprius, meaning "one's own", "individual" and perception, is the sense of the relative position of neighboring parts of the body and strength of effort being employed in movement.

Sufi Dervishes

Synesthesia

Outline

- The extraordinary sensory condition in which stimulation of one modality leads to perceptual experience in another. Literally, the term means “to perceive together.”
- https://www.youtube.com/watch?v=rk



typographic synesthesia